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EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS

Mark F. Meier
U.S. Geological Survey
Tacoma, Washington 98402

30 April 1974

Type I Progress Report for Period 1 March - 30 April 1974

(E74-10606) EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS Progress Report, 1 Mar. - 30 (Geological Survey) 4 p HC $4.00 CSCL 08L G3/13

N74-28839

Unclas 00606

Prepared for:

1342G

Goddard Space Flight Center
Greenbelt, Maryland 20771

Type I Progress Report
ERTS-1

a. Title: Evaluate ERTS imagery for mapping and detection of changes of snowcover on land and on glaciers.

ERTS-A Proposal No.: 342-7

b. GSFC ID No. of P.I.: IN 045

c. Statement and explanation of any problems that are impeding the progress of the investigation:

Acquisition of images taken prior to the 30 November cutoff date is still not complete. For some passes with acceptable cloud cover no data have been received; for some other passes the full set of frames or the full set of spectral bands has not been received. Data analysis has been hampered by this spotty receipt of primary information. Some cloud-free images of our critical test areas have been obtained from the University of Alaska in order to permit work to proceed on a timely basis.

d. Discussion of the accomplishments during the reporting period and those planned for the next reporting period:

Additional North Cascades drainage basins or subbasins have been measured on the Stanford ESIAC to complete a data set on snowcover changes in this area of intensive water resources development. Measurements have been started of snow-covered area and snowline altitude on images of the Mount Olympus region to obtain a longer time-series of data.

A scanning densitometer has been used at many different magnifications and different resolution element sizes to study 70 mm ERTS transparencies showing snowcover in small drainage basins, in order to evaluate resolution, density contrasts at snow/no snow boundary, and accuracy of snow-covered area measurements in presence of shadows on snow and other materials of similar radiance (ice, firn, light-colored rock). Several other studies of snow-mapping accuracy are continuing, as are evaluations of the several snow identification strategies which can be used by eye or machine (i.e., simple density slicing, slicing on density gradients, subjective or quantitative identification of snow in shadows, multispectral and cluster analysis, etc.).

Considerable additional work has been done on the measurement of ice movement and the movement of kinematic waves of thickness or crevassing on surging glaciers as seen on ERTS images.

Three articles on ERTS results were prepared or are in preparation.

e. Discussion of significant scientific results and their relationship to practical applications or operational problems including estimates of the cost benefits of any significant results.

Snowlines on a small (6 km^2) drainage basin were accurately identified on bulk ERTS images without use of digital processing, and results checked with high-altitude and ground-based photography. The area and approximate shape of snow patches as small as 20,000 m^2 (maximum dimension: 150 m) could be correctly identified with a magnifying scanning densitometer using an 80 m circular resolution element. Thus the resolution of ERTS is more than ample for most snow mapping needs.

Down-glacier movement of a kinematic wave as part of the Tweedsmuir Glacier surge was reported in the last progress report. Further study of these images suggests that a zone of intense crevassing (indicated by a darkening of the snow radiance) also spread up-glacier at a very high rate of speed, about 200 m per day. This tentative result may be of great importance to an understanding of surging glacier dynamics, as it apparently shows the location where rapid movement began and how this rapid movement spread along the length of the glacier.

Mount Baker, Washington, has a large crater south of the summit and an area north of the summit which emit considerable geothermal heat in the form of fumaroles and hot ground. Temperatures here are being monitored using an ERTS Data Collection Platform. Also, debris flows are occasionally released from the crater due to water saturation at the base of a heavy snowpack lying on hydrothermally altered hot ground. These debris flows present a possible hazard to life and property, as they are discharged down the Boulder Glacier toward Baker Lake, the upper of two major hydro-electric power reservoirs which are situated above the populated Skagit River valley. Study of ERTS images shows that the most recent debris flow (20-21 August 1973) can be clearly discerned and mapped. Thus ERTS images provide another important tool for monitoring this potential hazard.

f. A listing of published articles, and/or papers, preprints, in-house reports, abstracts of talks, that were released during the reporting period:

Paper presented at Second Annual Symposium on Applications of Satellite and Airplane Remote Sensing of Natural Resources in the Pacific Northwest:

Krimmel, R.M., Use of ERTS images in glacier studies.

Papers prepared for EROS book on use of ERTS images:

Post, Austin, Meier, M. F., and Mayo, L. R., Measuring the motion of surging glaciers.

Krimmel, R.M., Post, Austin, and Meier, M. F., Monitoring surging glaciers.

Frank, David, Debris avalanches at Mount Baker volcano.

Krimmel, R. M., and Meier, M. F., Measuring snow-covered area to predict reservoir inflow

Paper accepted for International Symposium on Remote Sensing in Glaciology, Cambridge, England:

Krimmel, R. M., and Meier, M. F., Glacier applications of ERTS images.

g. Recommendation concerning practical changes in operations, additional investigative effort, correlation of effort and/or results as related to a maximum utilization of the ERTS system:

None.

h. A listing by date of any changes in Standing Order Forms:

7 November 1972
1 May 1973

i. ERTS Image Descriptor forms:

In preparation.

j. Listing by date of any changed Data Request forms submitted to Goddard Space Flight Center/NDPF during the reporting period:

None.

k. Status of Data Collection Platforms:

N/A